VERIFYING AND CALIBRATING
UNIT WEIGHT MEASURES
AASHTO T 121

1.0   SCOPE

1.1   This method covers the procedure for checking the critical dimensions of a unit weight measure and calculating the volume of the measure, for the explicit use of measuring unit weight only.

1.2   When a measuring bowl for an air meter is used for unit weight determination, it shall conform to the requirements of AASHTO T 152 and shall be calibrated for volume as described in T 19

2.0   REFERENCE DOCUMENTS

2.1   AASHTO Standards
        M 231   Weighing Devices Used in the Testing of Materials
        T 19   Unit Weight and Voids in Aggregate
        T 121   Mass per Cubic Meter (Cubic Foot), Yield, and Air Content
                       (Gravimetric) of Concrete

3.0   APPARATUS

3.1   Balance, M 231, Class G5, readable to 1 gram with accuracy to 2 grams or 0.1% of the sample mass

3.2   Feeler Gauge, capable of measuring to 0.25 mm (.01 in.)

3.3   Two glass plates, a minimum of 6 mm (¼ in.) thick with a length and width at least 25 mm (1 in.) greater than the diameter of the unit weight measure. The edges of the plate shall be straight and smooth within a tolerance of 1.6 mm (0.0625 in.)

3.4   Ruler, readable to 1.0 mm (.04 in.)

3.5   Thermometer, readable to 0.5°C (1°F)

3.6   Vernier calipers, readable to 0.01 mm (.0004 in.)

4.0   PROCEDURE - VERIFICATION

4.1   Set the measure on top of one glass plate

4.2   Using the ruler, determine the following dimensions of the measure:
            1. Interior height
            2. Exterior height
            3. Outside diameter at mid-height
            4. Inside diameter at the top

4.3   Using the calipers, measure the wall thickness at the top

4.4   Place the second glass plate on top of the measure with the same orientation as the first.

4.5   Measure the distance between the plates on opposite sides along a center line of the measure.

4.6   Measure the width of the top glass plate at one point along the center line

4.7   Using the feeler gauge, attempt to insert the gauge between the glass plate and the rim

5.0   PROCEDURE - CALIBRATION

5.1   Set out sufficient clean tap water in appropriate container and allow water to acclimate to room temperature
5.2   Weigh the measure and one glass plate
5.3   Fill the measure with water at room temperature and cover with the glass plate in such a way as to eliminate bubbles and excess water
5.4   Weigh the measure, glass plate, and water
5.5   Remove glass plate and measure the temperature of the water
5.6   Determine density of water from attached table
5.7   Calculate the volume of the measure
5.8   Determine factor for measure by taking the inverse of the volume
5.9   Use permanent marker to record the volume (V) and factor (F) of the measuring bowl in both metric and U.S. customary units.

6.0   TOLERANCES

6.1   The dimension tolerances for the measure shall meet the following requirements:

REQUIREMENTS FOR MEASURES							
Capacity of Measure *		THICKNESS OF METAL					
		Bottom		Upper 38 mm (1.5 in.) of Wall		Remainder of Wall	
m^3	ft^3	mm	in.	mm	in.	mm	In.
0.006	0.2	5.0	0.20	2.5	0.10	2.5	0.10
0.011	0.4	5.0	0.20	5.0	0.20	3.0	0.12
0.014	0.5	5.0	0.20	5.0	0.20	3.0	0.12

* Capacity (m^3) = 3.14 (radius (m))^2 (height (m))

$$\text{Capacity } (ft^3) = \frac{\text{Capacity } (m^3)}{0.028}$$

6.2   The height of the measure shall be greater than 80 percent and less than 150 percent of the diameter of the measure.
6.3   The slope between pieces of plate glass in contact with the top and bottom shall not exceed 0.87 percent in any direction.
6.4   The top rim shall be smooth and plane within 0.25 mm (0.01 in.).

UNIT WEIGHT MEASURE OF CONCRETE VERIFICATION
AASHTO T 121

Measure Identification: _____

DIMENSIONS	
A. Interior height (mm)	
B. Exterior height (mm)	
Bottom thickness = B-A (mm)	
Wall thickness at the top (mm)	
C. Outside diameter at mid height (mm)	
D. Inside diameter at the top (mm)	
Wall thickness below 38 mm = 0.5 (C-D) mm	
Height / Diameter (%) = B ÷ C (100)	
Capacity $(m^3) = 3.14 \ (D/2)^2 \ (A) \ x \ 10^9$	

PLANENESS	
E. Distance between plates on side one (mm)	
F. Distance between plates on side two (mm)	
G. Width of top plate (mm)	
Slope (%) = [(E-G) - (F-G)] / G x 100	
Does the feeler gauge pass between the plate and rim?	

Remarks:

_____
_____
_____
_____

Verified by: _____

Date: _____   Next due date: _____

UNIT WEIGHT MEASURE OF CONCRETE
CALIBRATION
AASHTO T 19

Measure Identification: _____

MEASUREMENTS	
A. Mass of measure and glass plate (g)	
B. Mass of measure, glass plate, and water (g)	
C. Mass of Water = B - A (g)	
D. Temperature of Water (°C)	
E. Density of Water (kg/m^3) x 1000 = Density of Water (g/m^3)	

$$\text{Volume (V)} = \frac{\text{Mass of Water}}{\text{Density of Water}} \qquad = \underline{\hspace{3cm}} = \boxed{}$$

$$\text{Measure Factor (F)} = \frac{\text{Density of Water}}{\text{Mass of Water}} \quad = \underline{\hspace{3cm}} = \boxed{}$$

Remarks:

_____
_____
_____
_____

Calibrated by: _____   Date: _____

Next due date: _____

TEMP °C	DENSITY kg/m3	TEMP °C	DENSITY kg/m3	TEMP °C	DENSITY kg/m3	TEMP °C	DENSITY kg/m3
15.6	999.010	19.1	998.377	22.6	997.630	26.1	996.746
15.7	998.993	19.2	998.357	22.7	997.608	26.2	996.720
15.8	998.975	19.3	998.336	22.8	997.585	26.3	996.694
15.9	998.958	19.4	998.316	22.9	997.563	26.4	996.668
16.0	998.940	19.5	998.296	23.0	997.540	26.5	996.642
16.1	998.923	19.6	998.275	23.1	997.516	26.6	996.616
16.2	998.906	19.7	998.255	23.2	997.491	26.7	996.590
16.3	998.888	19.8	998.235	23.3	997.467	26.8	996.562
16.4	998.871	19.9	998.214	23.4	997.442	26.9	996.534
16.5	998.853	20.0	998.194	23.5	997.418	27.0	996.506
16.6	998.836	20.1	998.174	23.6	997.393	27.1	996.477
16.7	998.818	20.2	998.153	23.7	997.369	27.2	996.449
16.8	998.801	20.3	998.133	23.8	997.344	27.3	996.421
16.9	998.784	20.4	998.112	23.9	997.320	27.4	996.393
17.0	998.766	20.5	998.092	24.0	997.294	27.5	996.365
17.1	998.749	20.6	998.072	24.1	997.268	27.6	996.337
17.2	998.731	20.7	998.051	24.2	997.242	27.7	996.308
17.3	998.714	20.8	998.031	24.3	997.216	27.8	996.280
17.4	998.697	20.9	998.011	24.4	997.190	27.9	996.252
17.5	998.679	21.0	997.990	24.5	997.164	28.0	996.224
17.6	998.662	21.1	997.970	24.6	997.138	28.1	996.196
17.7	998.645	21.2	997.947	24.7	997.111	28.2	996.168
17.8	998.627	21.3	997.925	24.8	997.085	28.3	996.140
17.9	998.610	21.4	997.902	24.9	997.059	28.4	996.111
18.0	998.592	21.5	997.879	25.0	997.033	28.5	996.083
18.1	998.757	21.6	997.857	25.1	997.007	28.6	996.055
18.2	998.557	21.7	997.834	25.2	996.981	28.7	996.027
18.3	998.540	21.8	997.812	25.3	996.955	28.8	995.999
18.4	998.520	21.9	997.790	25.4	996.929	28.9	995.971
18.5	998.499	22.0	997.766	25.5	996.903	29.0	995.943
18.6	998.479	22.1	997.744	25.6	996.877	29.1	995.914
18.7	998.459	22.2	997.721	25.7	996.851	29.2	995.886
18.8	998.438	22.3	997.698	25.8	996.825	29.3	995.858
18.9	998.418	22.4	997.676	25.9	996.799	29.4	995.830
19.0	998.398	22.5	997.653	26.0	996.773		